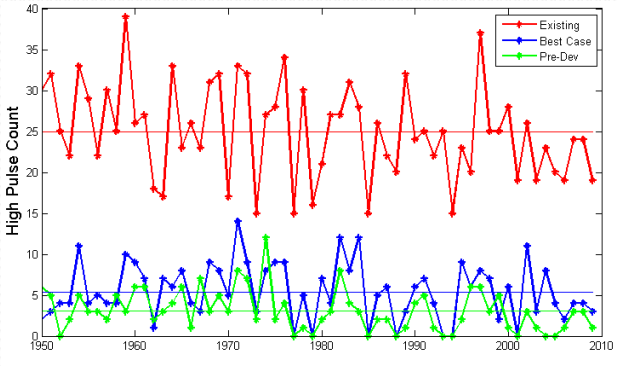
Bear Creek Watershed Model Approach and Inputs

Jeff Burkey and Scott Miller
King County DNRP-WLRD
Bear Creek Watershed-Scale Stormwater Plan
11/15/2016

Modeling Approach Overview

Physical Parameters, Existing Conditions, Future Land Use, BMP information



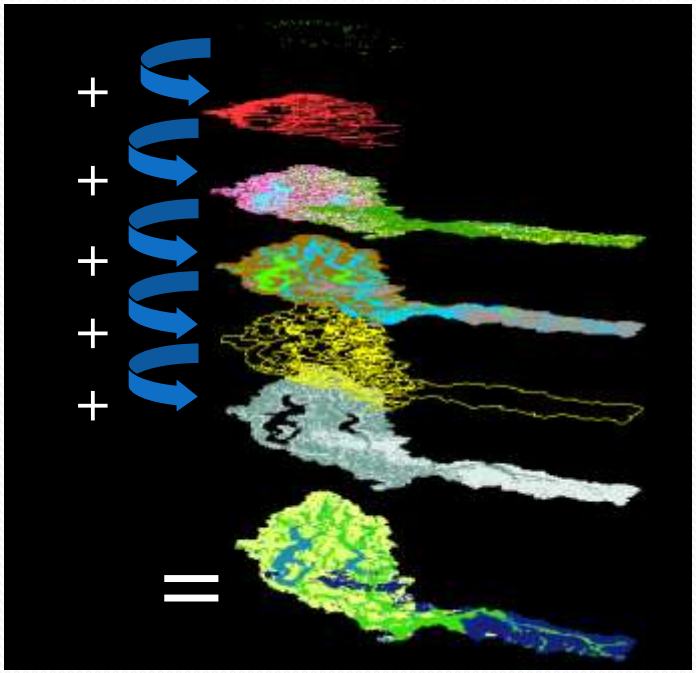
HSPF Hydrologic Modeling → SUSTAIN BMP Modeling → Modeling Output and Analyses → **Achieve Goals?**

Yes!

No

HSPF Watershed Modeling

- Hydrologic Simulation Program – Fortran (HSPF)
- Simulate current, future and historic (pre-disturbed) conditions of watershed.
- Calibrate model using observed water quality and flow data.



Wetlands (NWI)

Impervious land cover

Land Use

Soils

Catchments

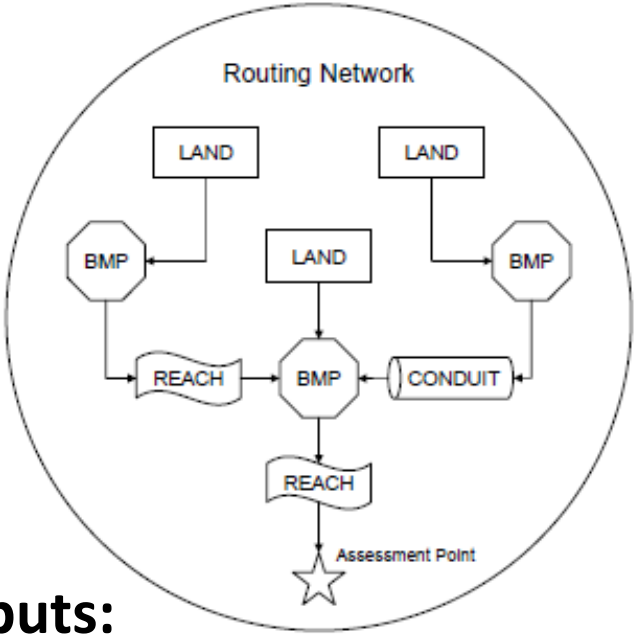
Slope Percent

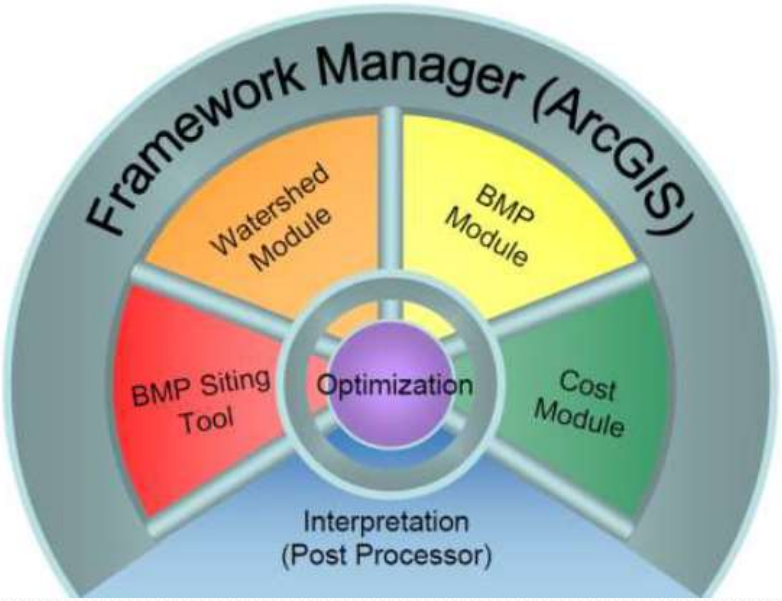
Integrated Layer (HRUs)

EPA SUSTAIN Modeling

System for **U**rban **S**tormwater **T**reatment and **A**nalysis **In**tegration (SUSTAIN)

U.S. EPA model developed to assist stormwater managers in selecting cost-effective stormwater BMPs to meet watershed goals.





Model Inputs:

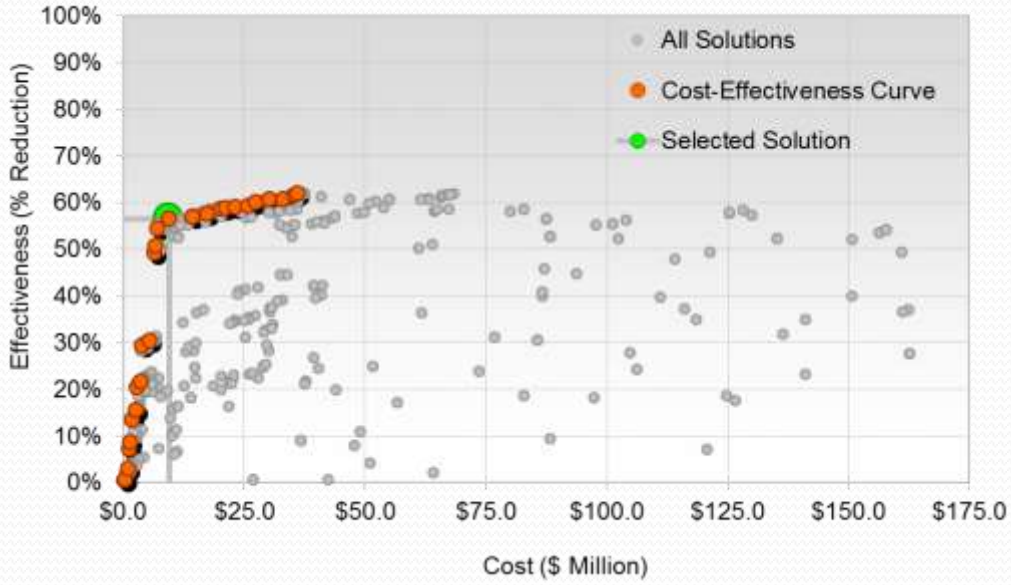
HSPF Model Output

BMP Design and Cost Assumptions

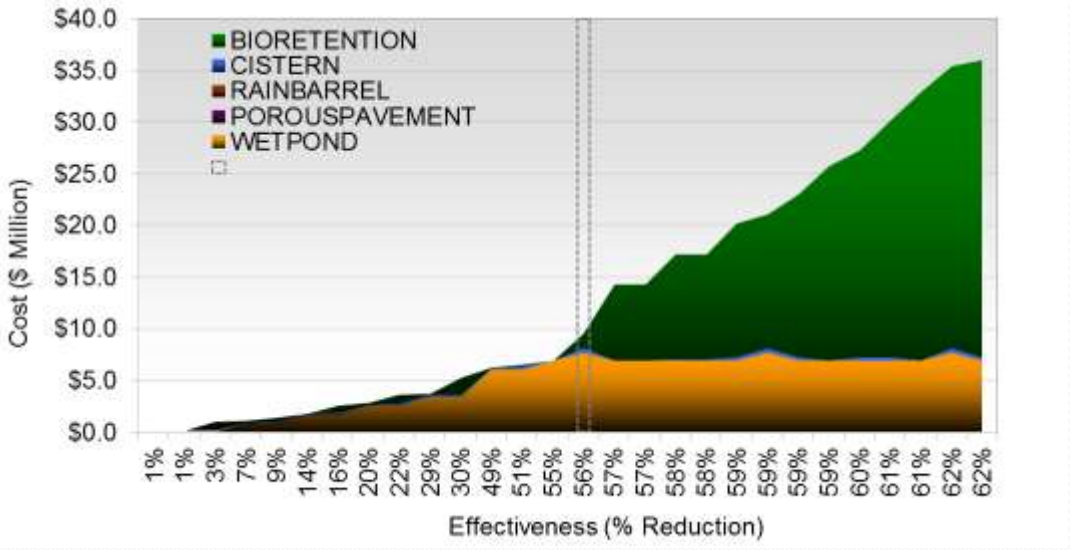
Flow or water quality goals

SUSTAIN Modeling Output examples

Cost-Effectiveness

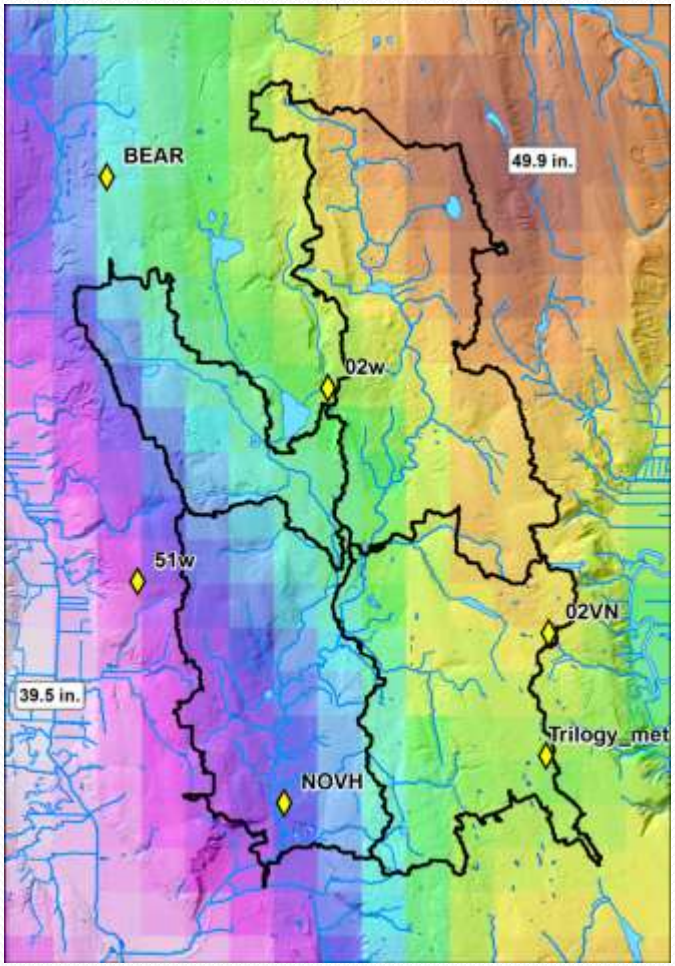


BMP Cost-Distribution

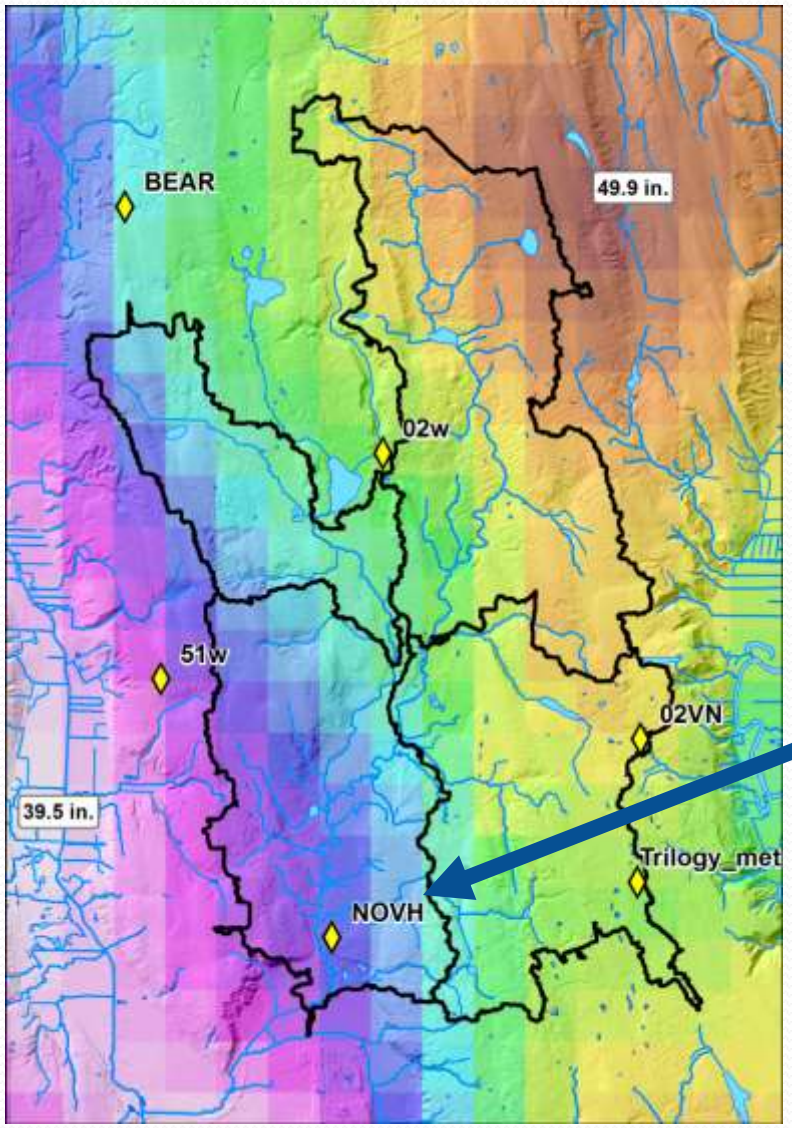


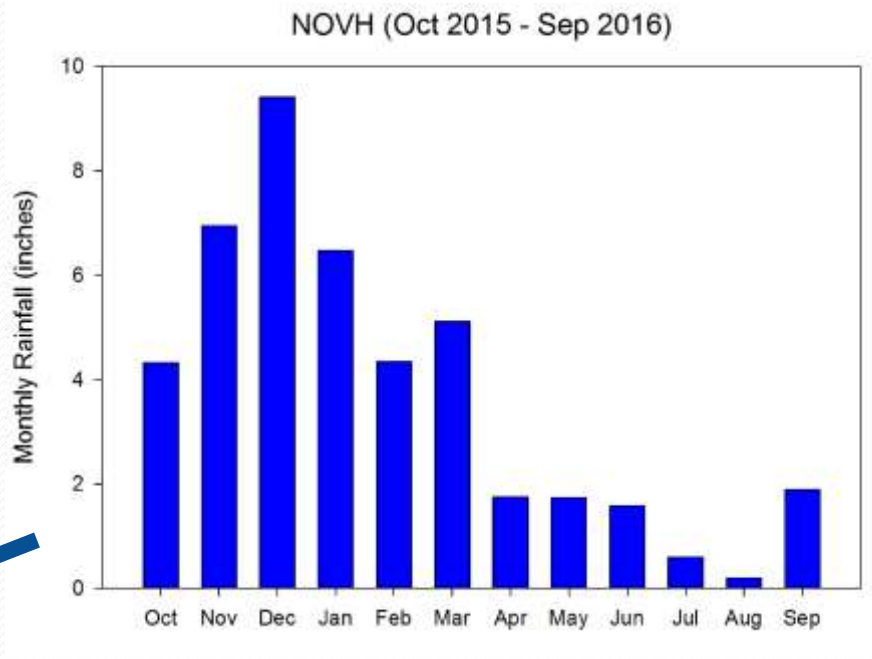
Rainfall

- Precipitation from local gauges
- Grouped into four precipitation zones based on PRISM 30-year normal annual depth for 2010
  - NE 47.2 in
  - SE 45.7 in
  - NW 43.8 in
  - SW 42.6 in
- Precipitation may be modeled to represent effects of climate change

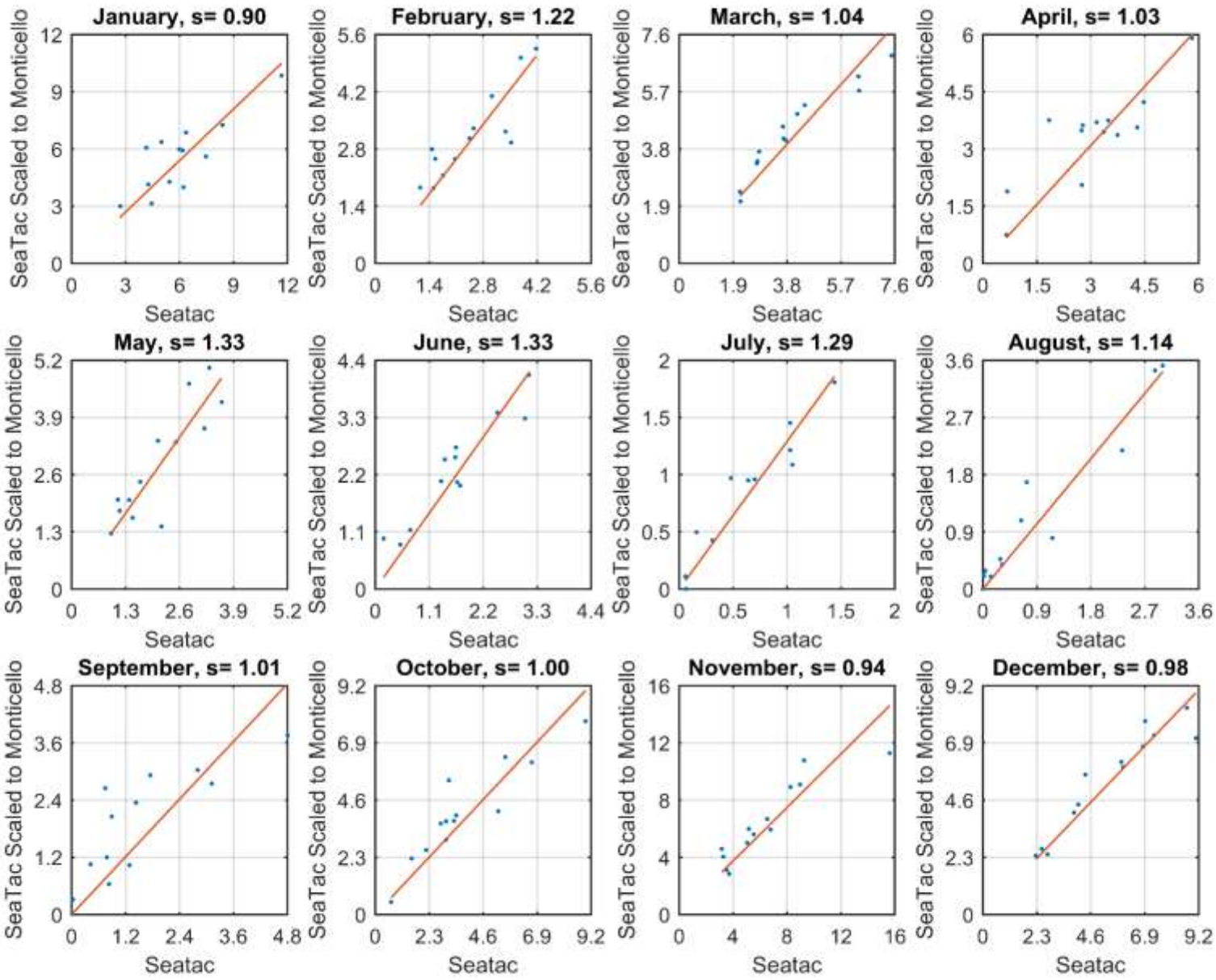


Monthly Rainfall



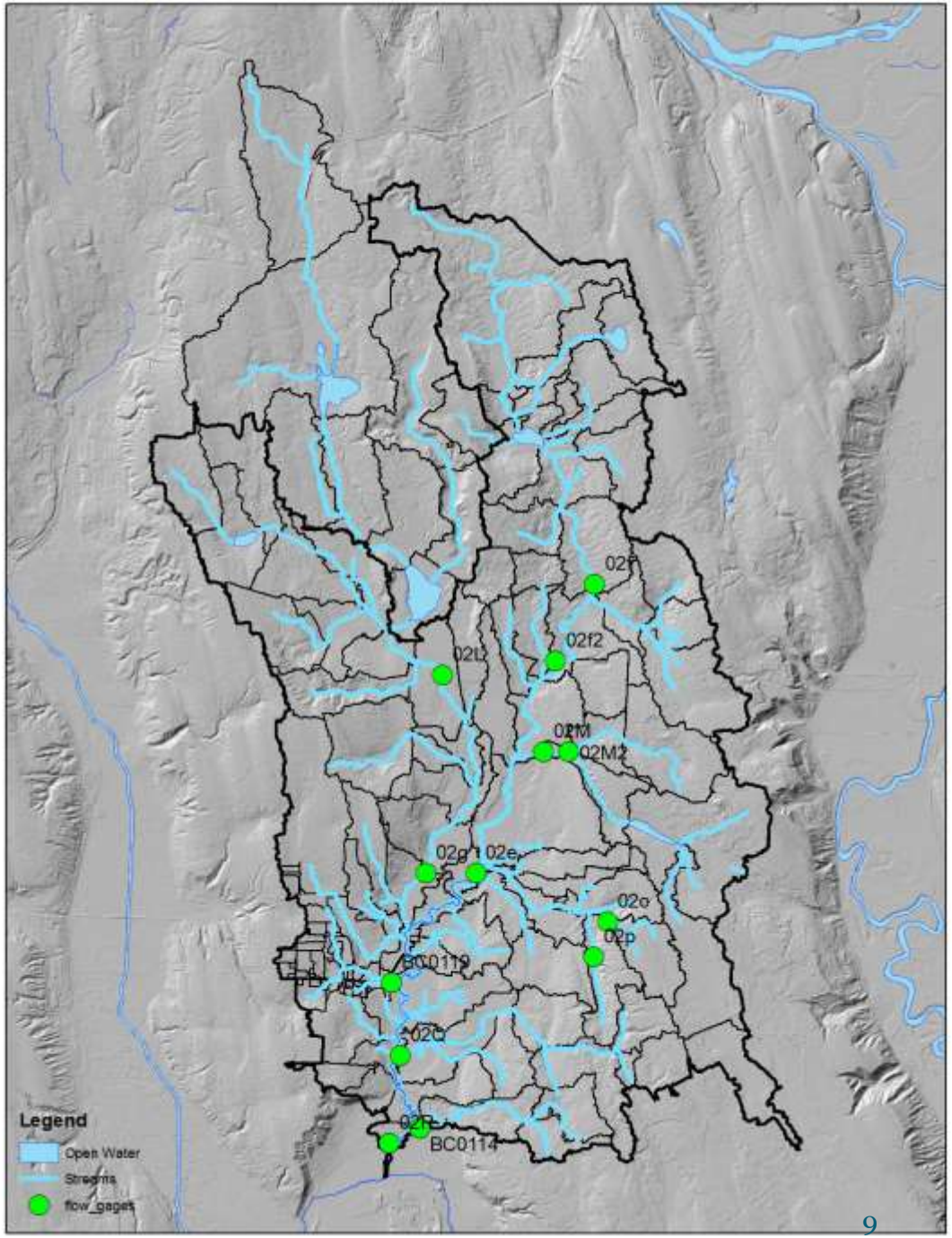


Translating Sea-Tac Rainfall to Area

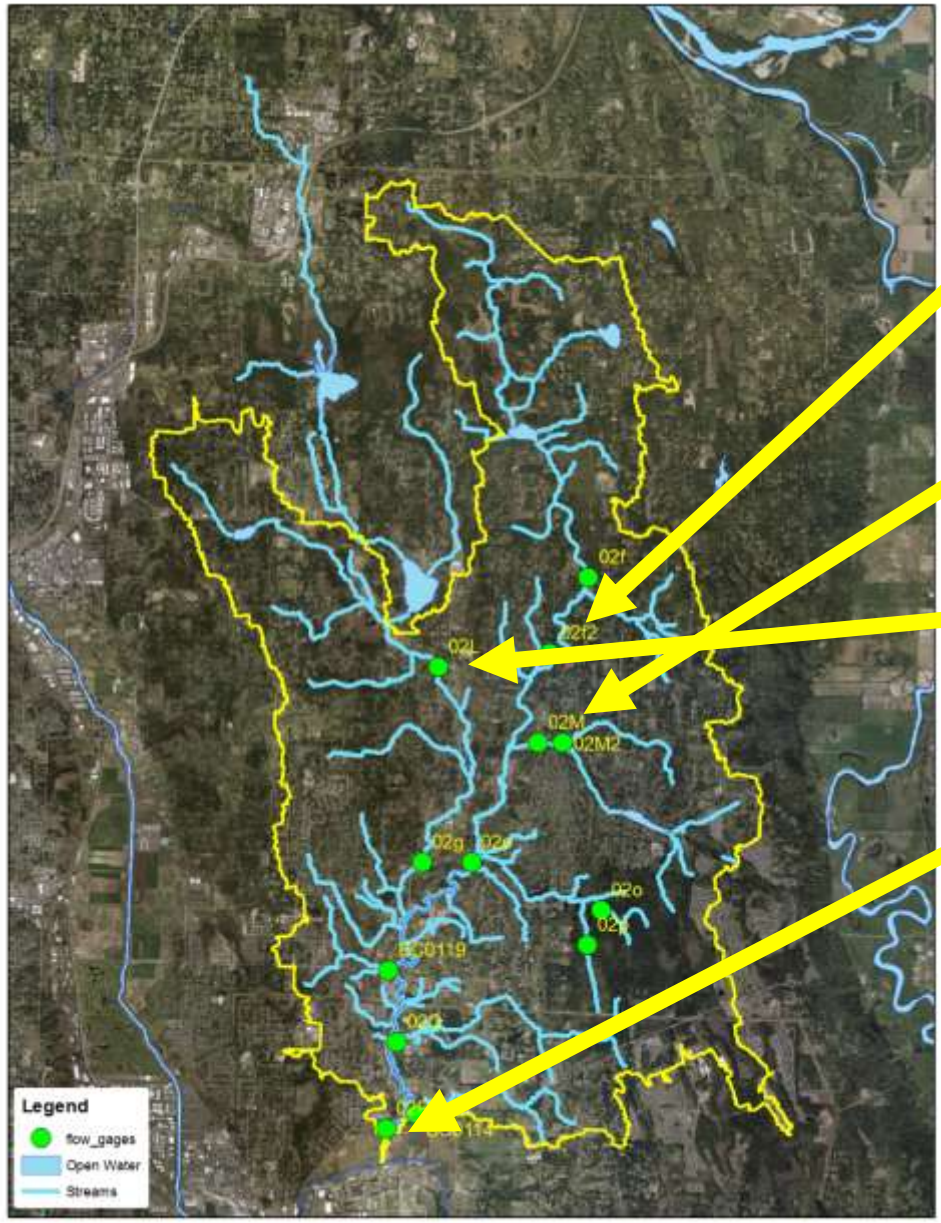


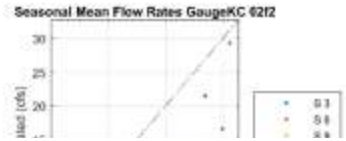
Model Resolution

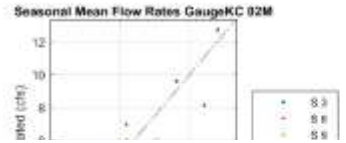
- Approx 100 Catchments range from a few acres to hundreds acres.

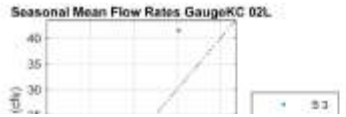


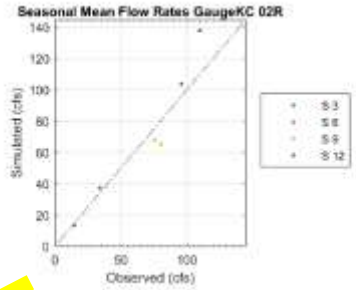
Interim Calibration Results

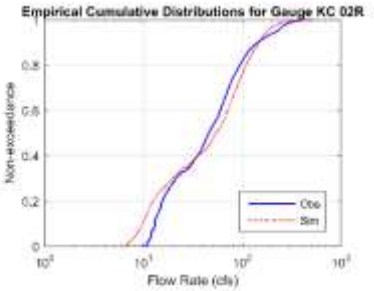


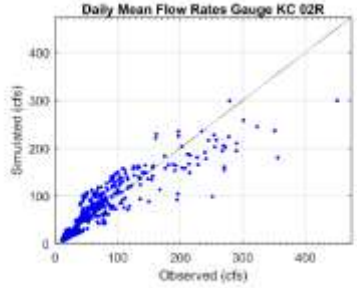


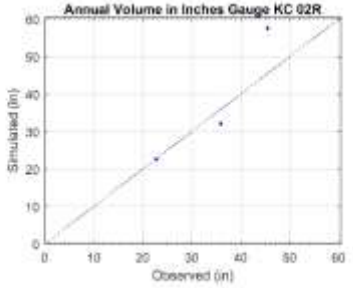




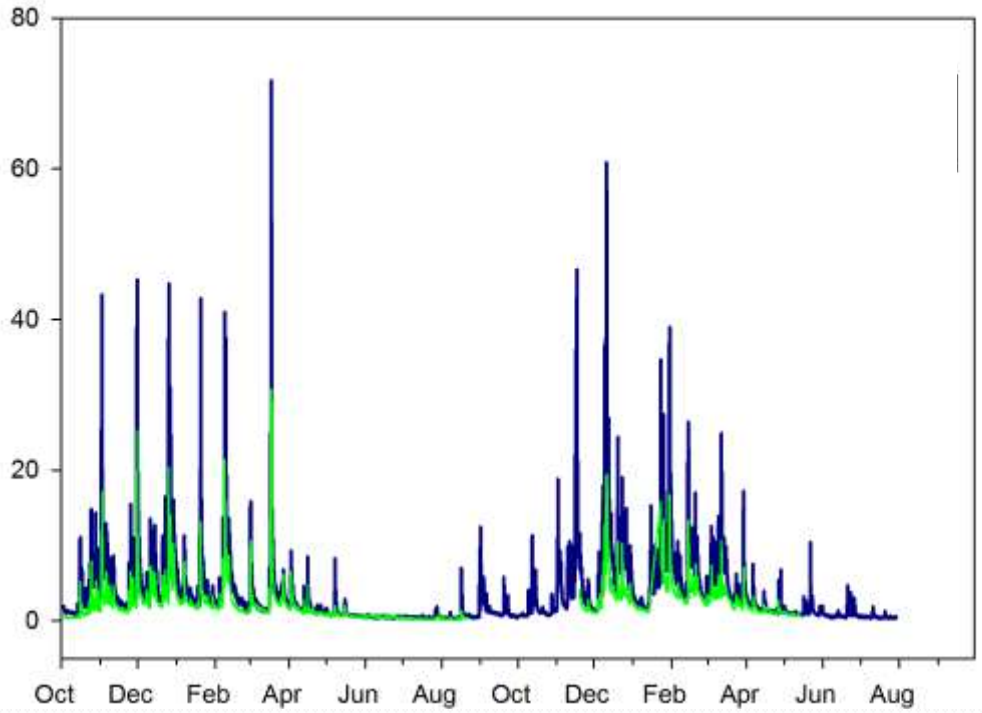








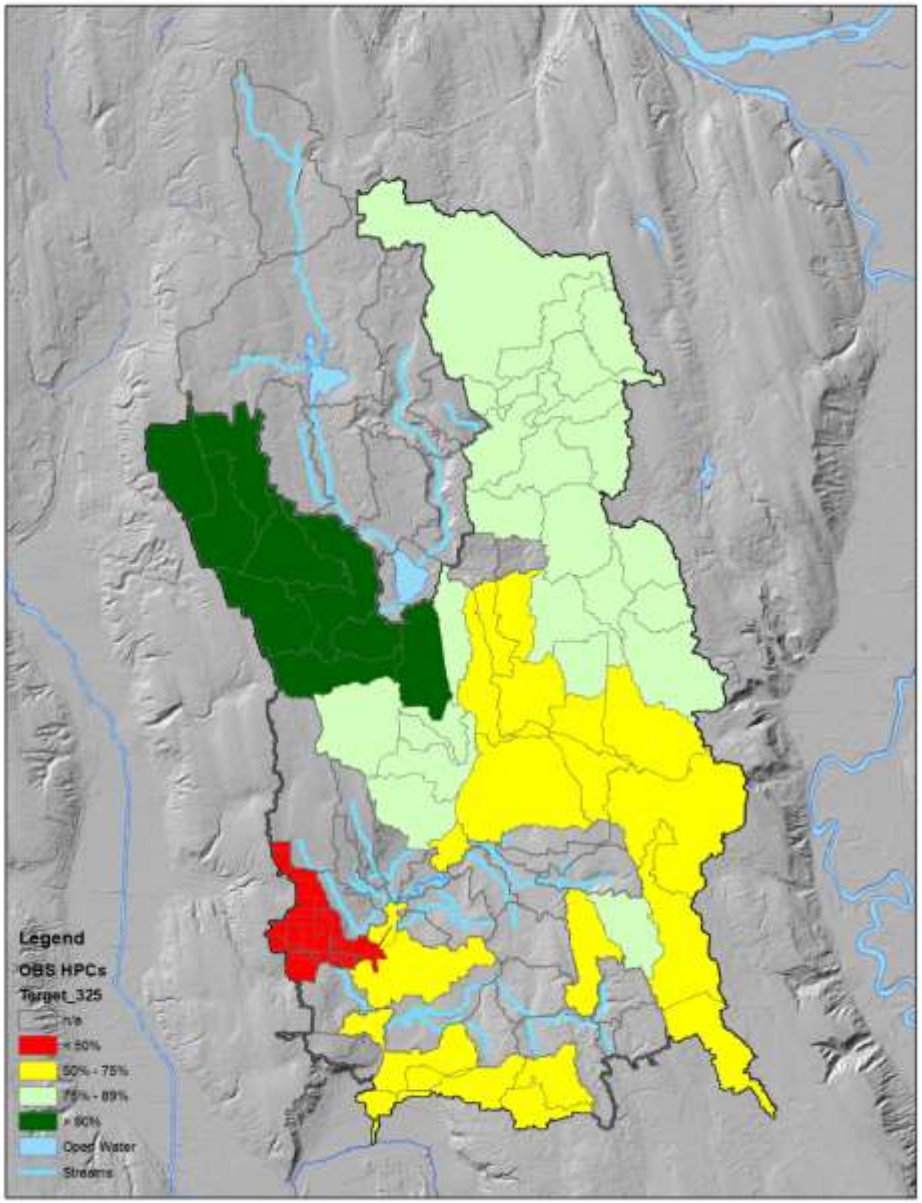
Flow rates Impacts of disturbance

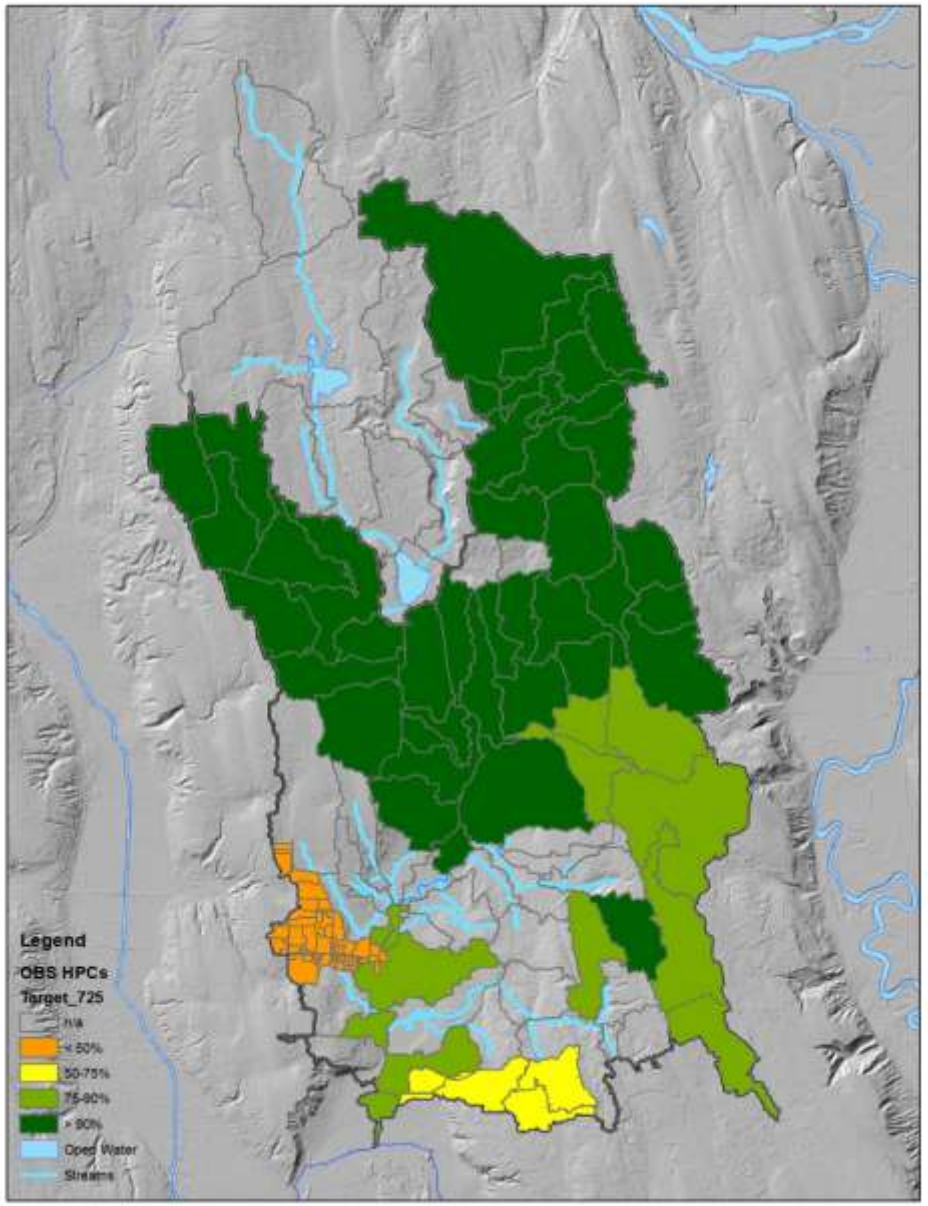


- Scale basin to compare flow to similar size
  - Mackey 445 acres
  - Monticello 358 acres

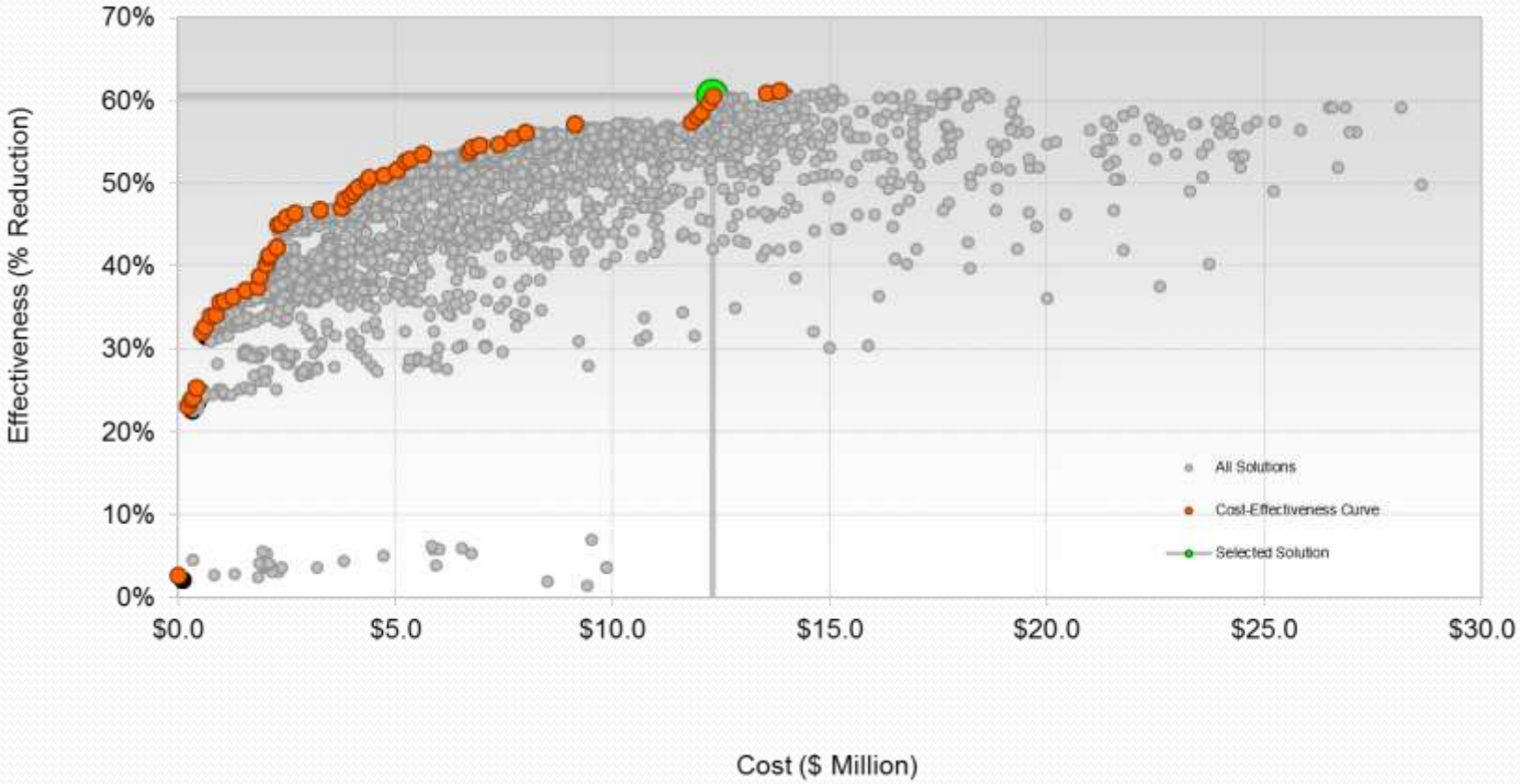
Year	Gauge	Catchment	HPC	HPR	TQMean
2015	'02O'	'BEA325'	10	138	0.35
2015	'02e'	'BEA300'	11	146	0.35
2015	'02f2'	'BEA500'	9	138	0.38
2015	'02g'	'BEA700'	9	137	0.39
2015	'02M'	'BEA410'	11	146	0.35
2015	'02M2'	'BEA480'	11	153	0.37
2015	'02R'	'BEA010'	11	145	0.38
2015	'BC0114'	'BEA020'	10	160	0.38
2015	'BC0119'	'MON030'	17	320	0.33

High Pulse Count (HPC 3/7)

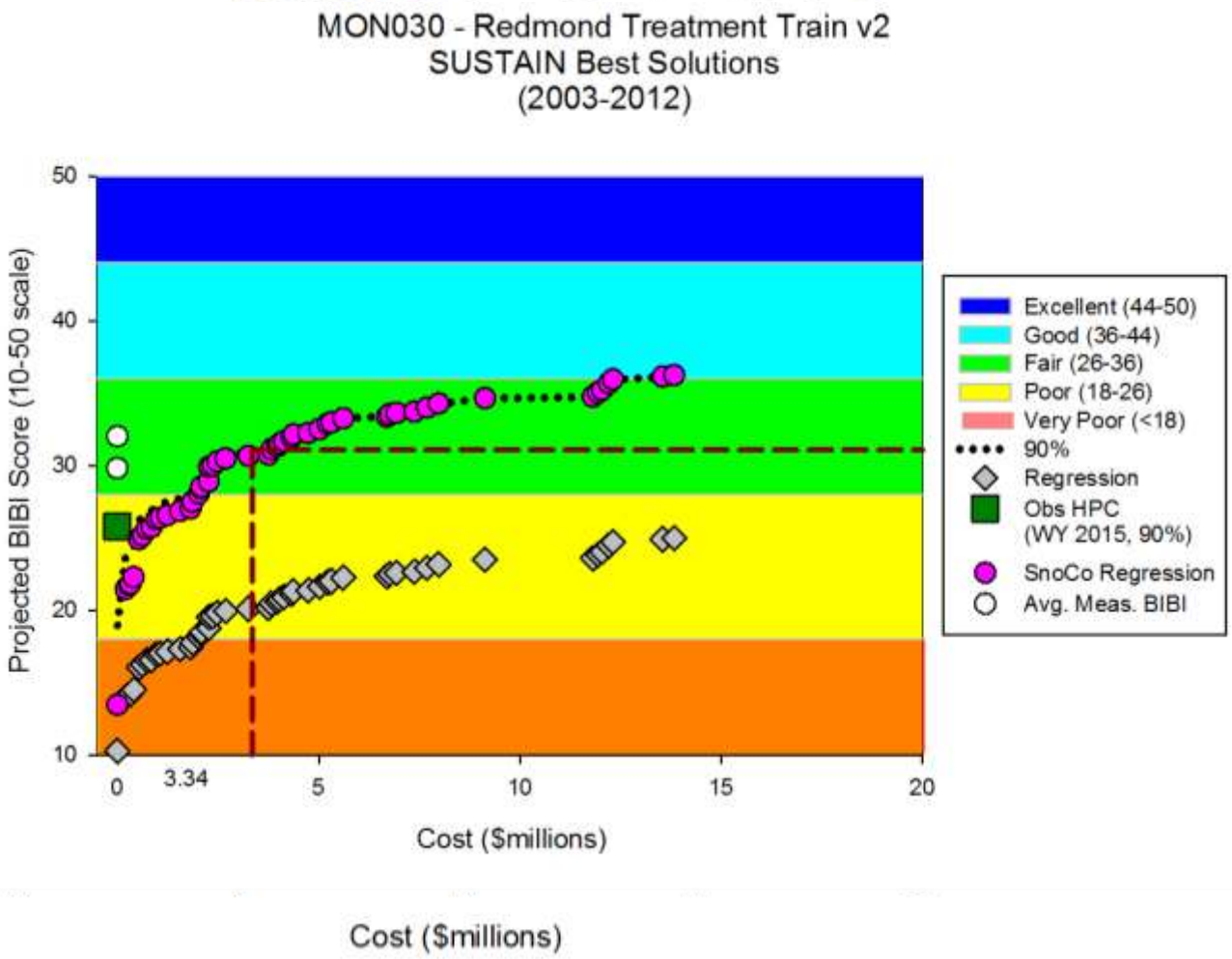




SUSTAIN Results (HPC Reduction for Monticello Creek)



Projected B-IBIs (10-50 scale)



Questions?

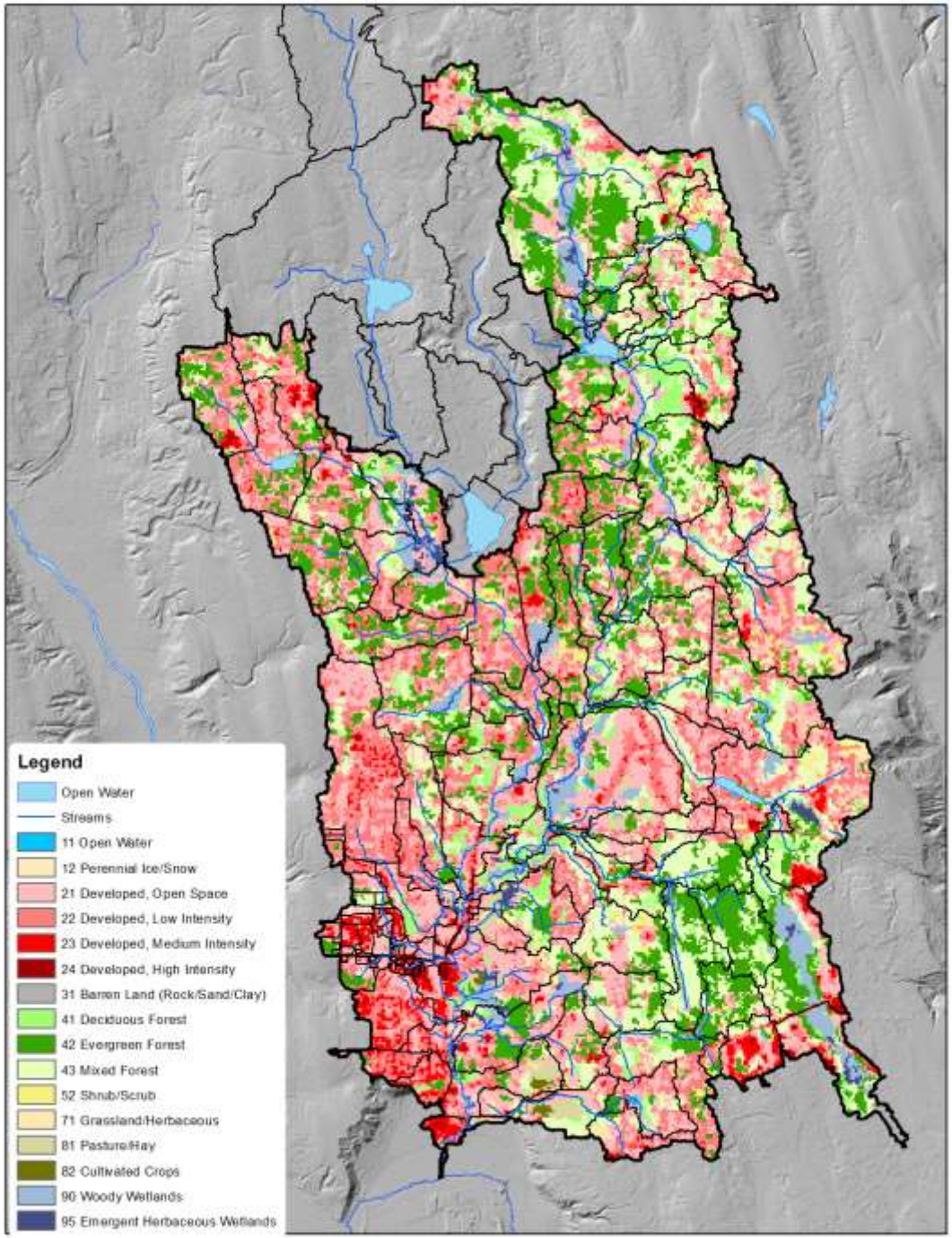
Bear Creek Land Use Conditions

Jeff Burkey
King County DNRP-WLRD
Bear Creek Watershed-Scale Stormwater Plan
11/15/2016

Existing Land Use (NLCD 2011)

- Disturbed Dev
  - 52%
    - 11% Impervious
- Disturbed Other
  - 2 %
- Undisturbed
  - 46%

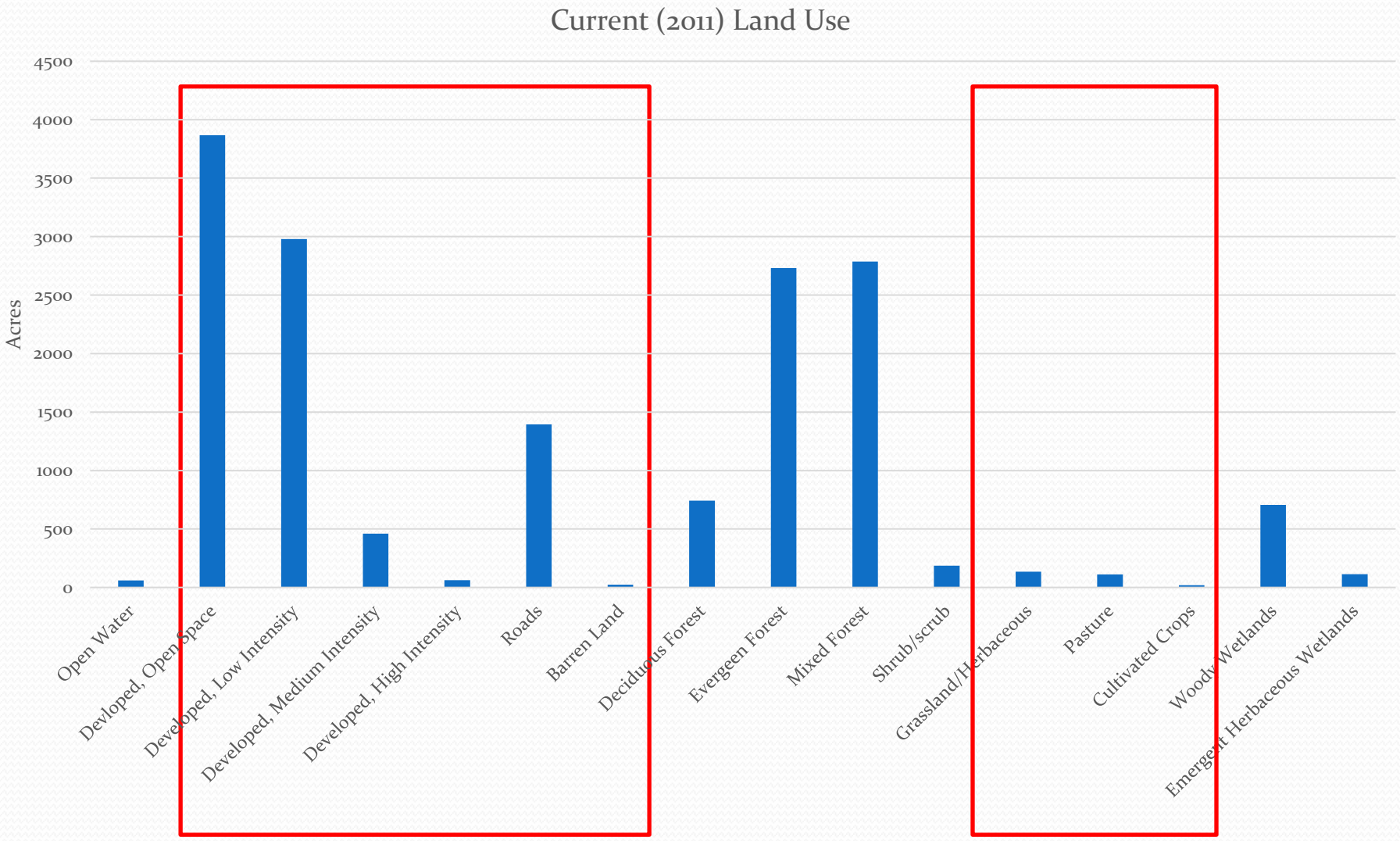
Basin Area 16,385 acres



DRAFT: Land Cover Distributions

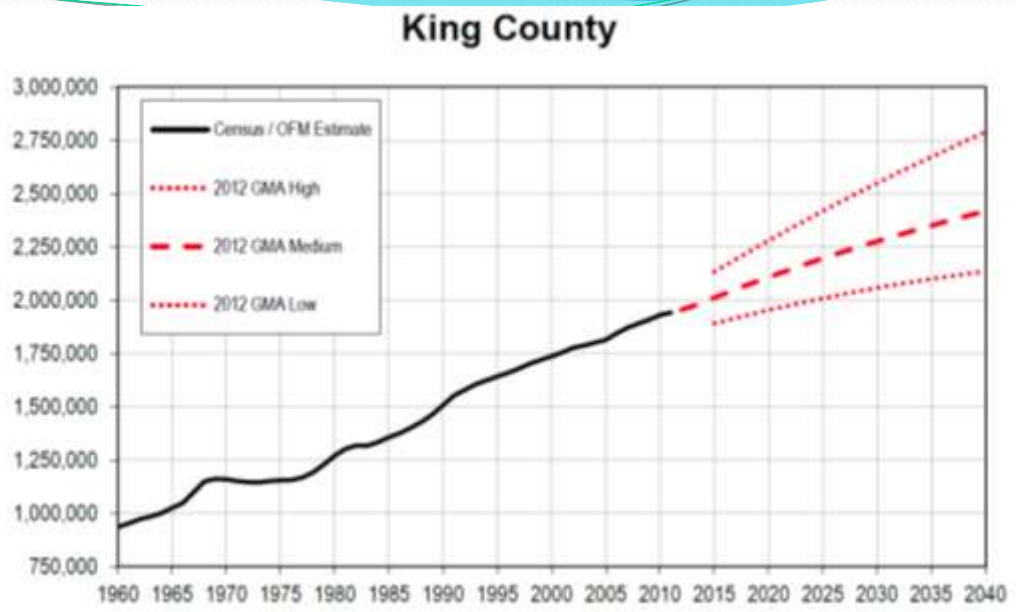
	Grass												
Description	Road	High	Low	Cleared	Grass	Forest	water	Scrub	Agri	wetlands	EIA-Low	EIA-Hi	EIA-Rds
Open Water							100.0%						
Perennial Ice/Snow								100.0%					
Devloped, Open Space			94.5%								5.5%		
Developed, Low Intensity			94.3%								5.7%		
Developed, Medium Intensity			64.6%								35.4%		
Developed, High Intensity		19.0%										81.0%	
Barren Land				50.0%							50.0%		
Deciduous Forest						100.0%							
Evergeen Forest						100.0%							
Mixed Forest						100.0%							
Shrub/scrub								100.0%					
Grassland/Herbaceous					100.0%								
Pasture									100.0%				
Cultivated Crops									100.0%				
Woody Wetlands										100.0%			
Emergent Herbaceous Wetlands										100.0%			
Roads	10.0%												90.0%

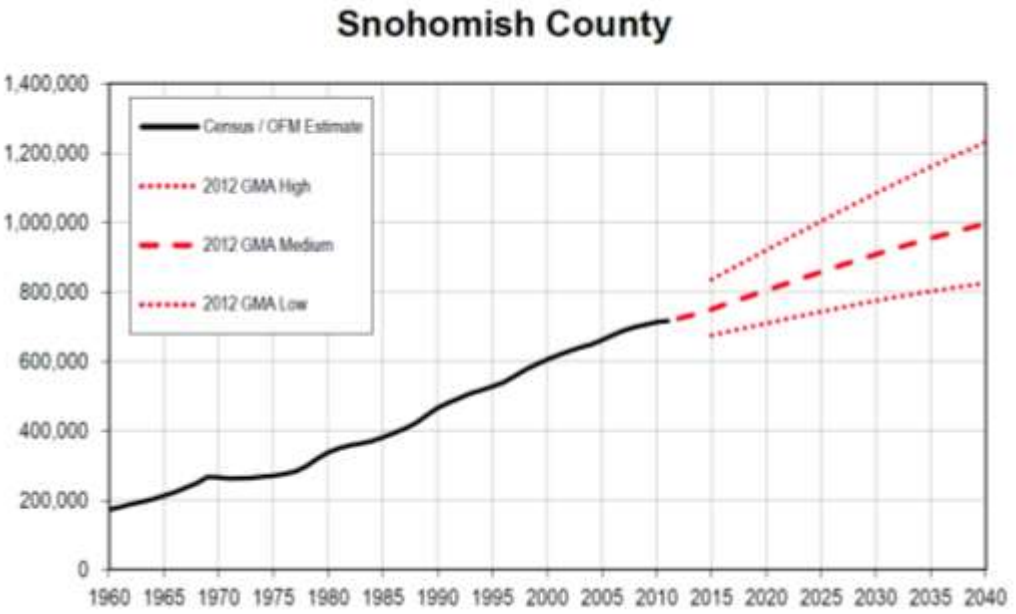
Current Land Use (2011)



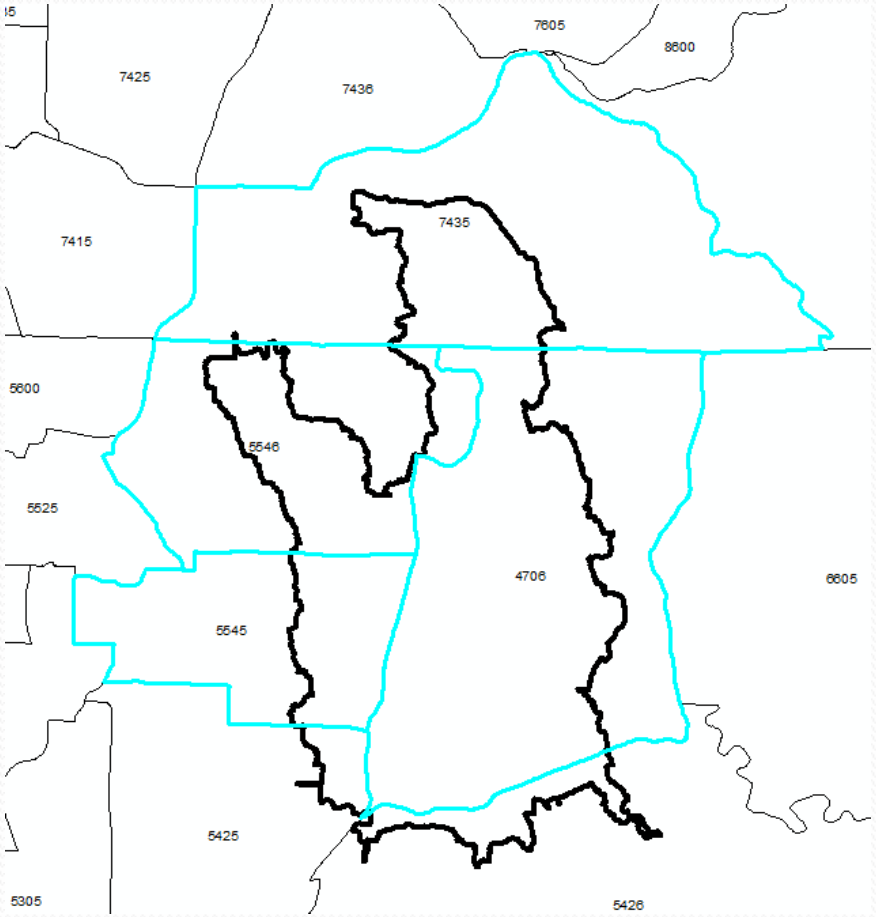
Population Growth Projections

- King County
  - 2010 - 1.9 mil
  - 2040 - 2.4 mil
- Snohomish County
  - 2010 - 0.7 mil
  - 2040 - 1.0 mil

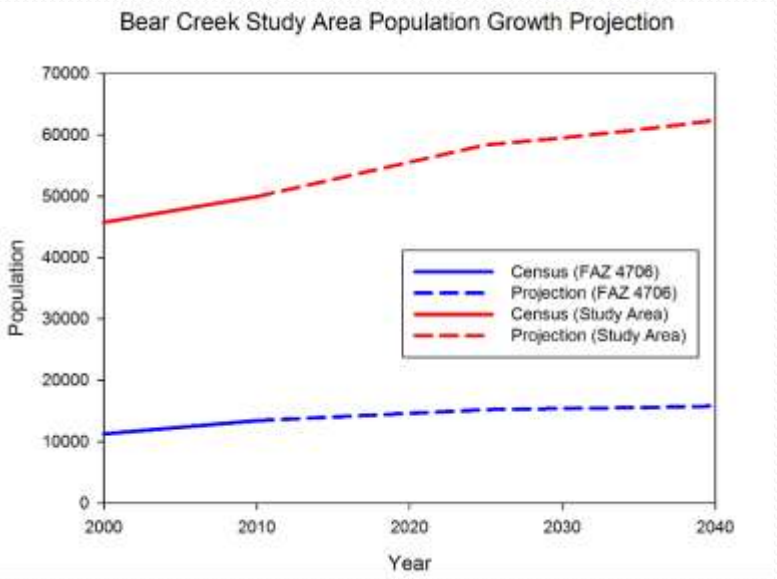




Puget Sound Regional Council Population Projection by FAZ

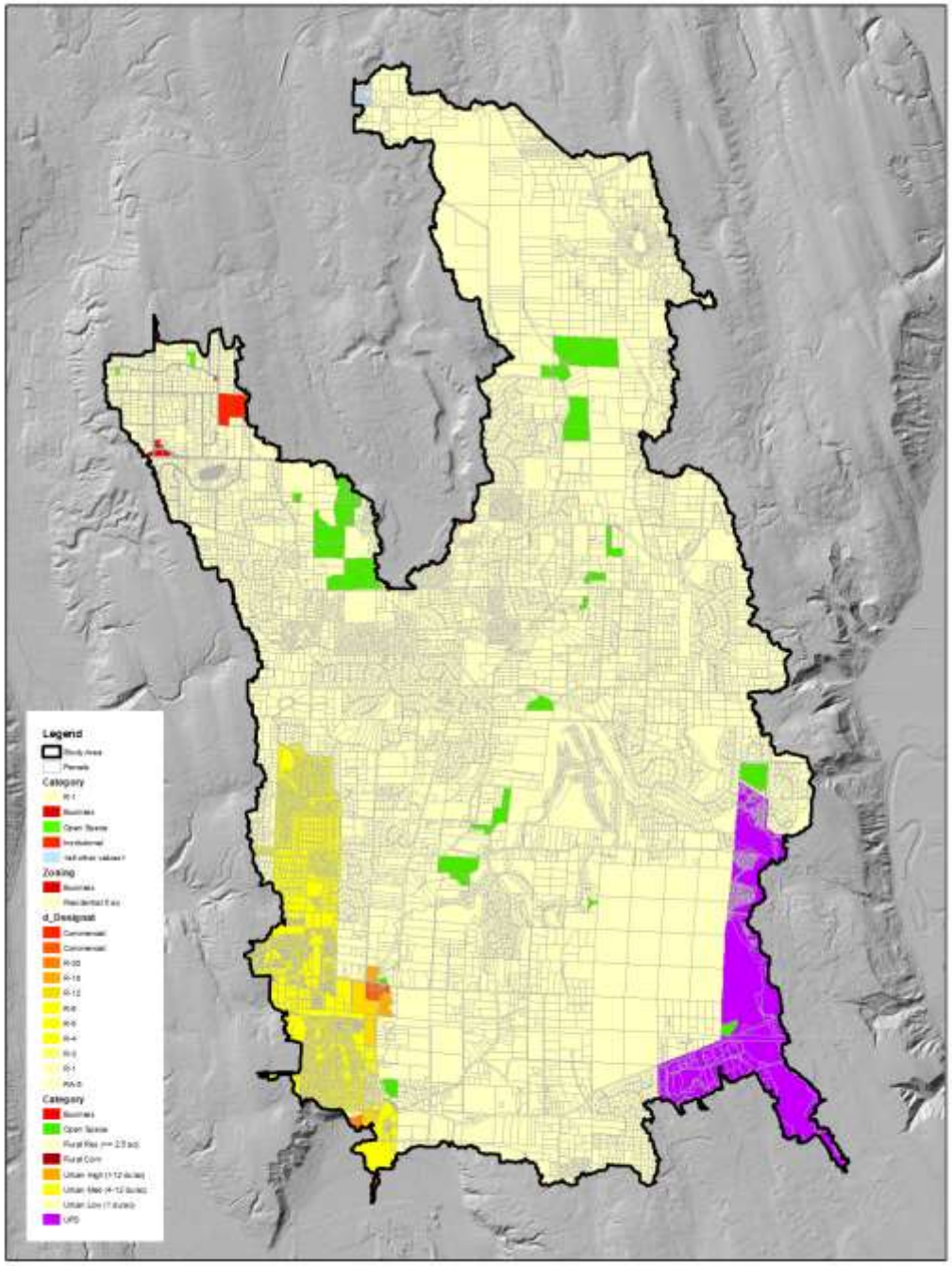


FAZ	2000	2010	2025	2030	2035	2040
4706	11,265	13,433	15,206	15,414	15,530	15,803
5545	11,608	13,324	16,871	16,867	17,512	17,858
5546	15,413	15,282	17,743	18,642	19,124	19,828
7435	7,464	7,901	8,568	8,601	8,682	8,874
Total	45,750	49,940	58,388	59,524	60,848	62,363



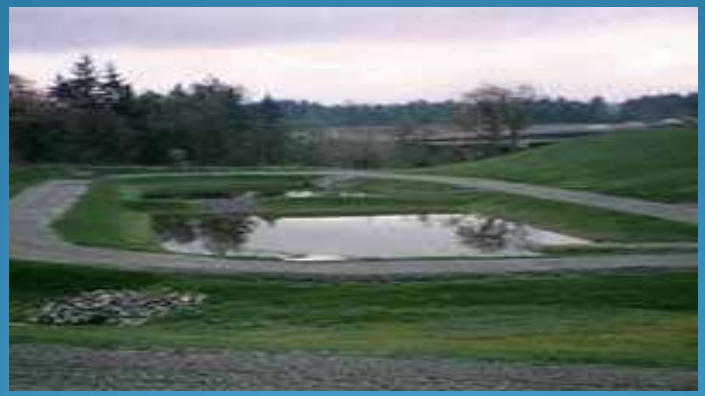
Future

- Based on Comprehensive Land Use Plans (2040)
- Some existing development occurred at densities greater before KC's Current Comp Plan in the Rural areas.



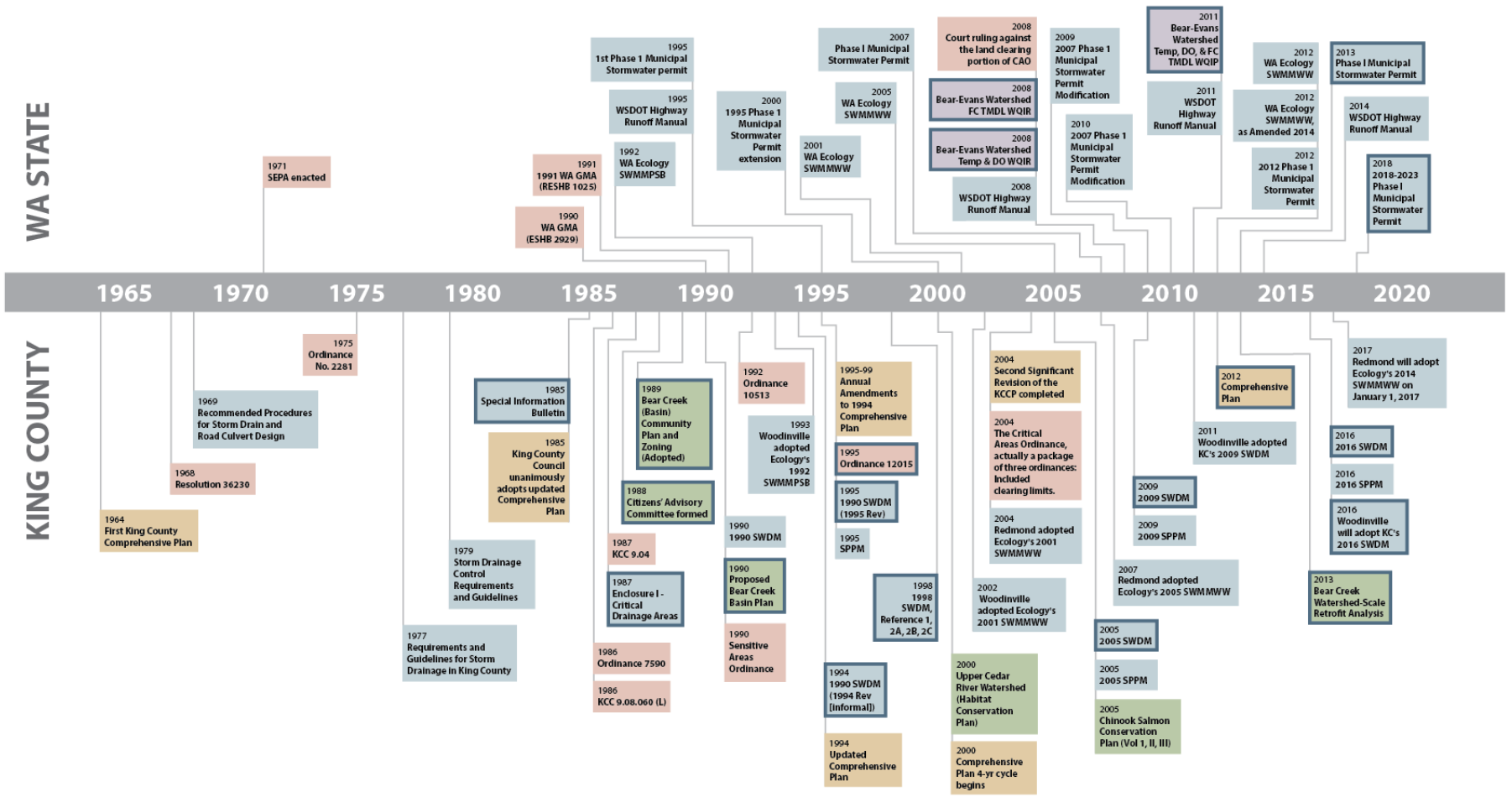
Questions?

Bear Creek – Regulations and Existing Stormwater Infrastructure



Mark Wilgus, P.E.
King County DNRP-WLRD
Bear Creek Watershed-Scale Stormwater Plan
11/15/2016

BEAR CREEK WATERSHED REGULATORY HISTORY



Acronyms

CAO	Critical Areas Ordinance
ESHB	Engrossed substitute House bill
GMA	Growth Management Act
KC	King County
KCC	King County Code
KCCP	King County Comprehensive Plan
RESHB	Re-engrossed substitute House bill
SEPA	State Environmental Policy Act
SPPM	Stormwater Pollution Prevention Plan
SWDM	Surface Water Design Manual
SWMMPSB	Stormwater Management Manual for Puget Sound Basin
SWMMWW	Stormwater Management Manual for Western Washington
TMDL	Total Maximum Daily Load
WA Ecology	Washington State Department of Ecology
WQIP	Water Quality Improvement Plan
WQIR	Water Quality Improvement Report
WSDOT	Washington State Department of Transportation

KEY

Acts, laws, ordinances, and Code (KCC); and court rulings.

State and County legislative actions broadly addressing environmental quality, and more specifically regarding stormwater control and water quality; court action regarding legislative actions.

Comprehensive Plan

Articulates long-range growth and land use planning to support "resilient, healthy, diverse, and sustainable communities"; with specific elements to "protect resources and enhance quality of life". Prior to GMA, KCC drove Comp Plan; after GMA, Comp Plan drives KCC.

Basin Plans and Analysis

Environmental protection / improvement plans for specific basins and resources.

Stormwater Permits
Stormwater Manuals
Stormwater Pollution Prevention Plans

Stormwater manuals and pollution prevention plans are implementations of stormwater permits. Over time, stormwater management has evolved additively from moving water away from structures -> flood control -> erosion control -> water quality treatment and pollution prevention.

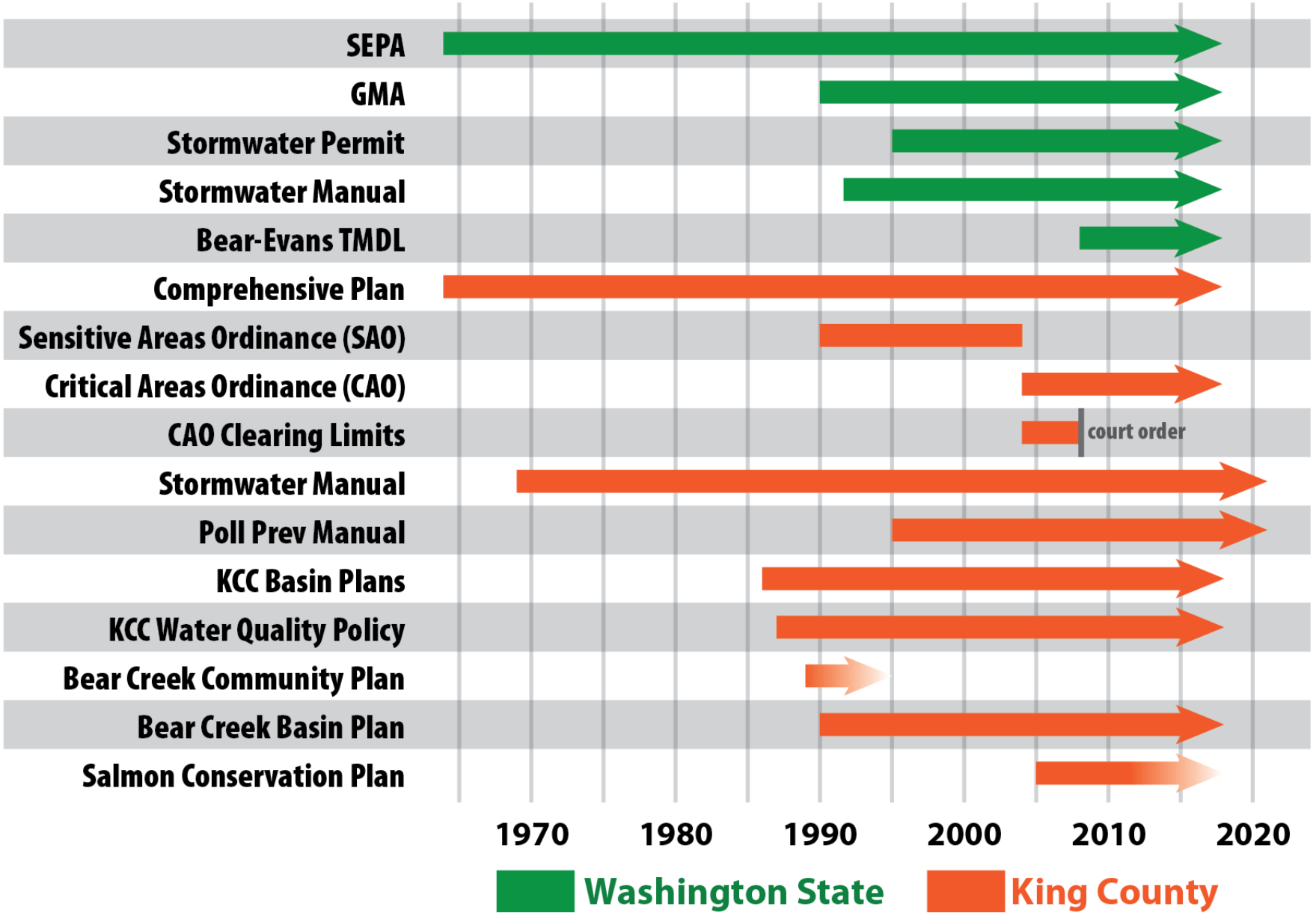
TMDL
(Total Maximum Daily Load)

"A planning tool and potential starting point for restoration or protection activities with the ultimate goal of attaining or maintaining water quality standards". When called out in a state stormwater permit, has regulatory weight to drive cleanup and pollution prevention initiatives.

Bear Creek Watershed focus

Laws, permits, stormwater manuals, etc. with a Bear Creek Watershed nexus; i.e., calling out or uniquely specific to Bear Creek Watershed.

BEAR CREEK WATERSHED REGULATORY TIMELINE



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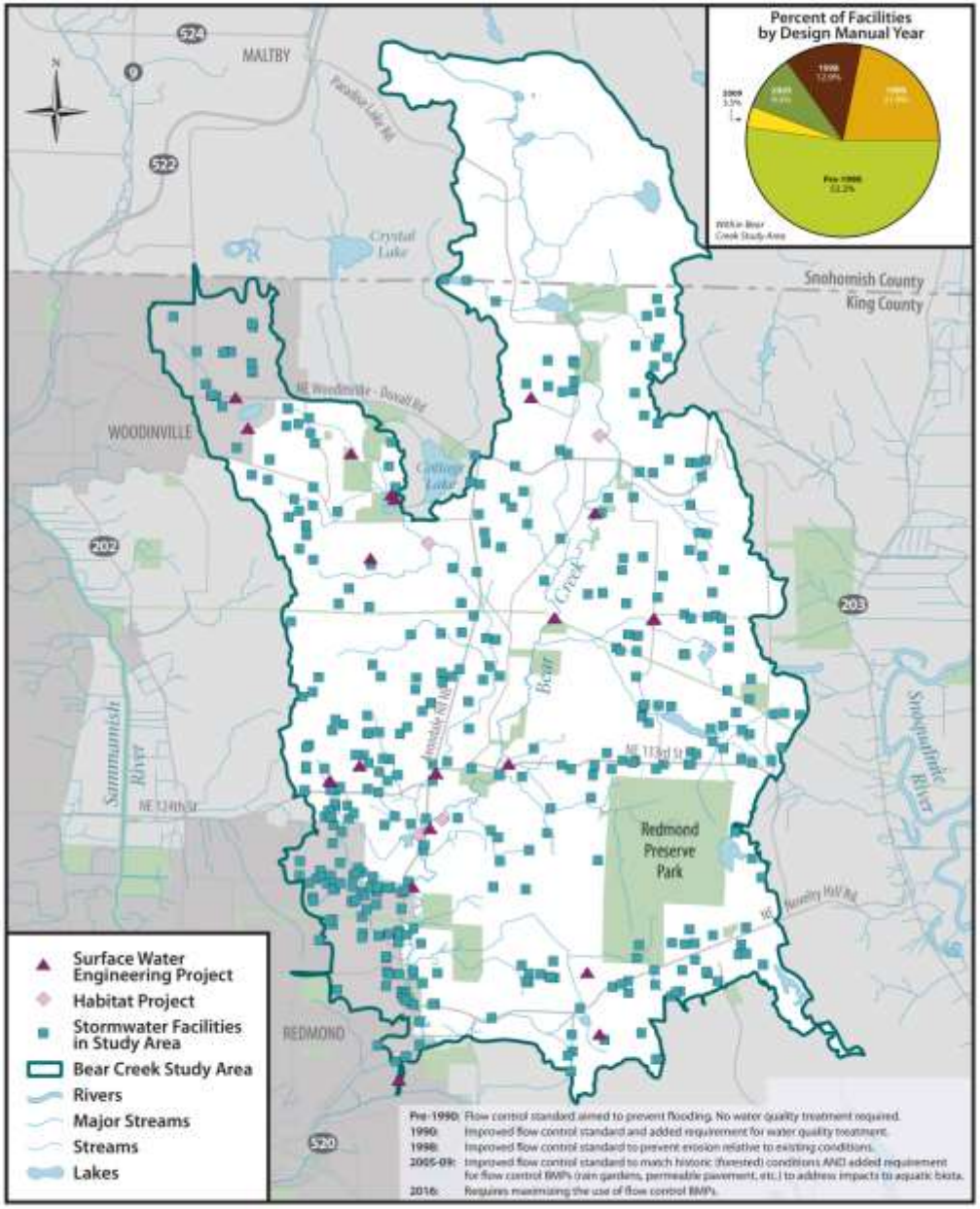
Existing Stormwater Facilities, Surface Water Engineering and Habitat Restoration Projects in the Bear Creek Study Area

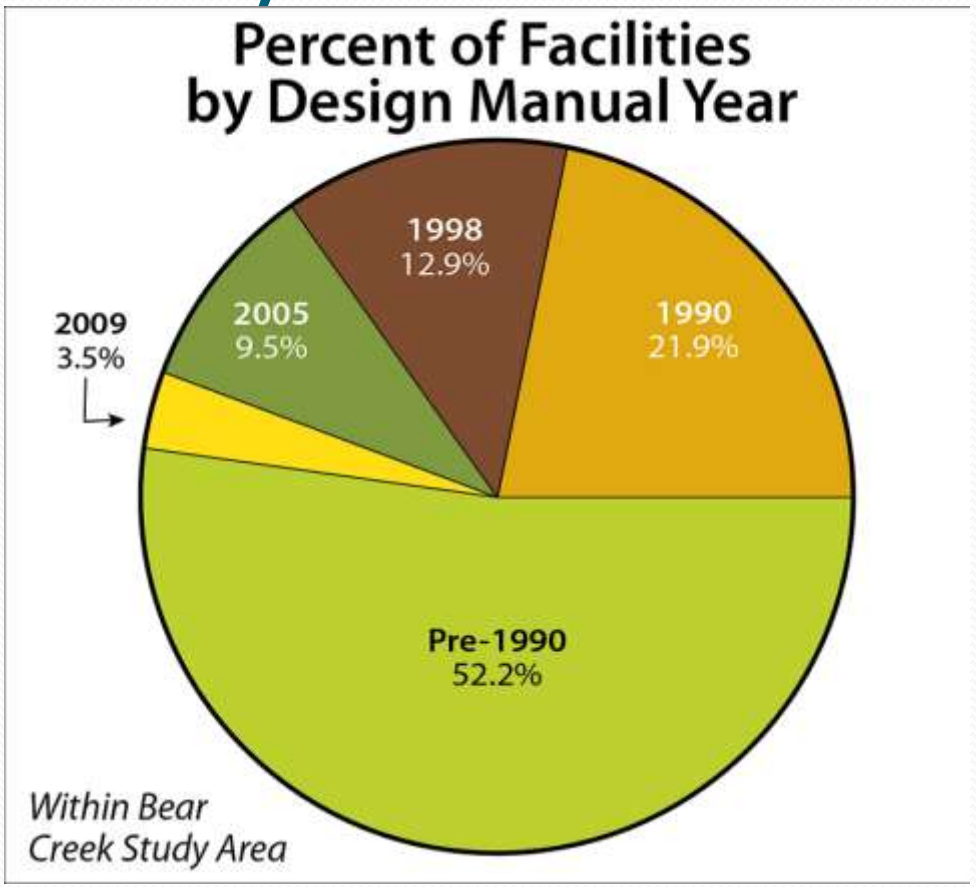


King County
Department of Natural Resources and Parks
Water and Land Resources Division

0 0.5 1 Mile

October 2016

Existing Stormwater Facilities (Ponds, vaults)



Overview of Design Manual Requirements for Stormwater Facilities/BMPs

	Flow Control Standard	Water Quality
Pre - 1990	• Aimed to prevent flooding.	• No water quality treatment required.
1990	• Improved modeling methods (results in larger facilities)	• Added water quality treatment.
1998	• Improved to prevent erosion relative to existing conditions.	
2005-9	• Improved to require matching historic (forested) conditions • Flow Control BMPs (aka LID BMPs) incentivized and required at minimum levels	
2016	• Requires maximizing the use of flow control BMPs.	

Low Impact Development (LID's) = Flow Control BMPs

- Preservation and use of native vegetated surfaces to fully disperse runoff
- Use of other pervious surfaces to disperse runoff
- Roof downspout infiltration
- Permeable pavements
- Bioretention
- Limited infiltration systems
- Reduction of development footprint.

Questions???